



# Projecting Vulnerability to Inundation Due to Sea Level Rise in the San Francisco Bay and Delta

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Projected sea level rise over the next century will affect the shoreline of the Bay/Delta, newly inundating some areas and increasing the risk of levee failure in others.

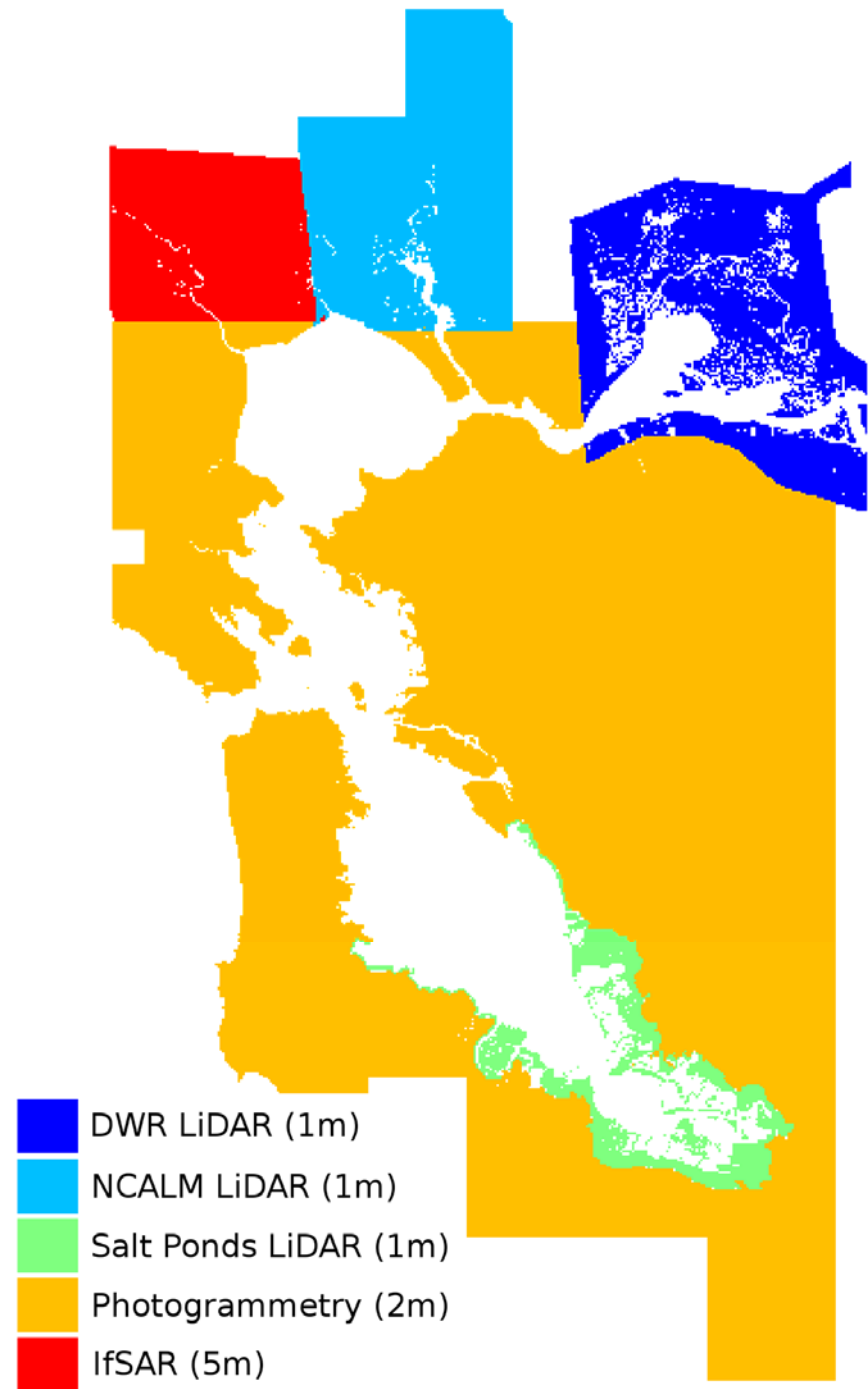
A new elevation dataset has been assembled allowing a more detailed and accurate assessment than previously possible.

The present analysis shows areas *at risk* of inundation, based purely on the elevation data. The effect of levees is, for now, ignored.

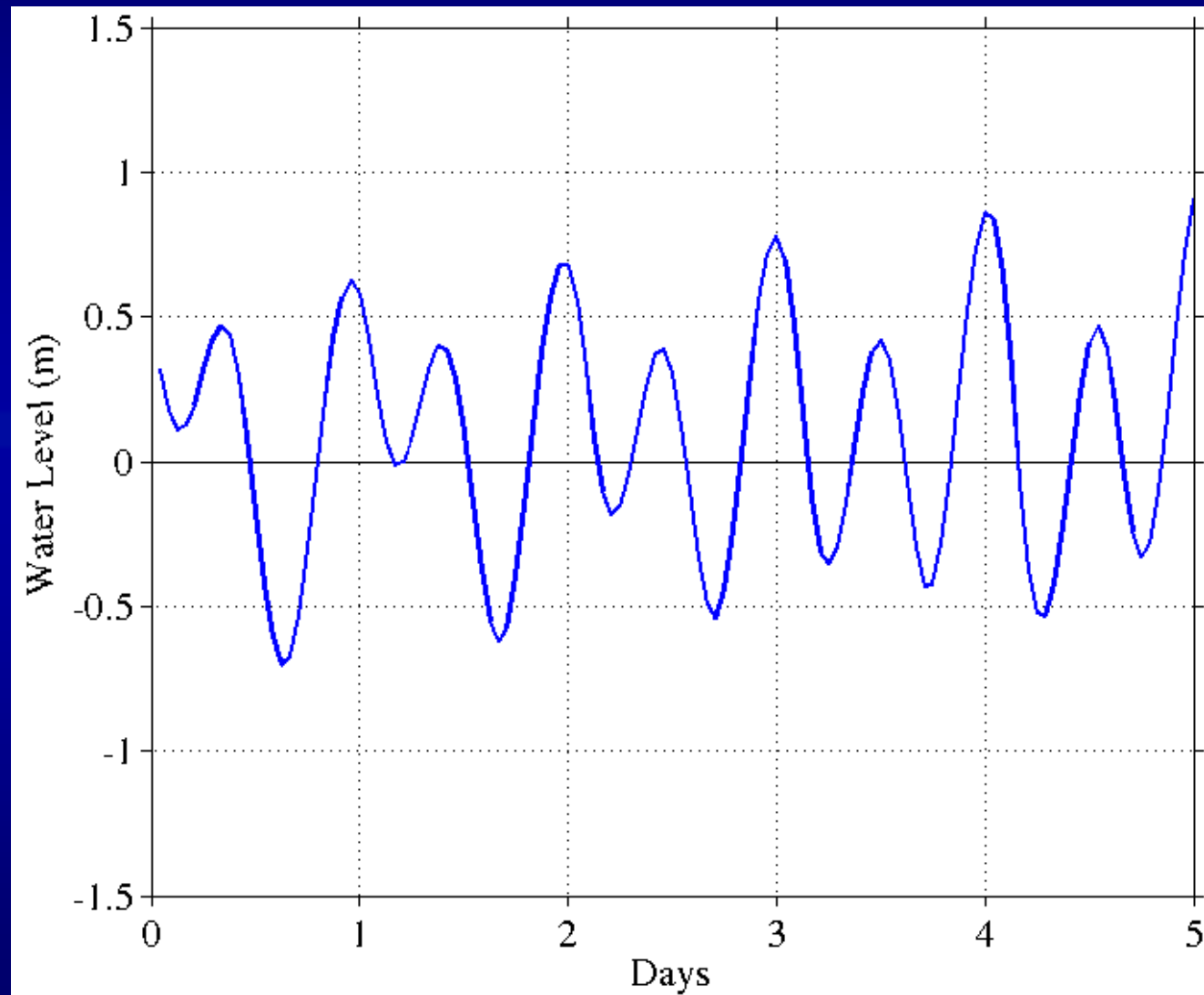
Funded by through the California Energy Commission's Public Interest Energy Research Program (PIER) through the California Climate Change Center at Scripps Institution of Oceanography, and the CALFED Science Program CASCaDE Project.

A new composite elevation dataset is complete, covering the entire Bay and Delta.

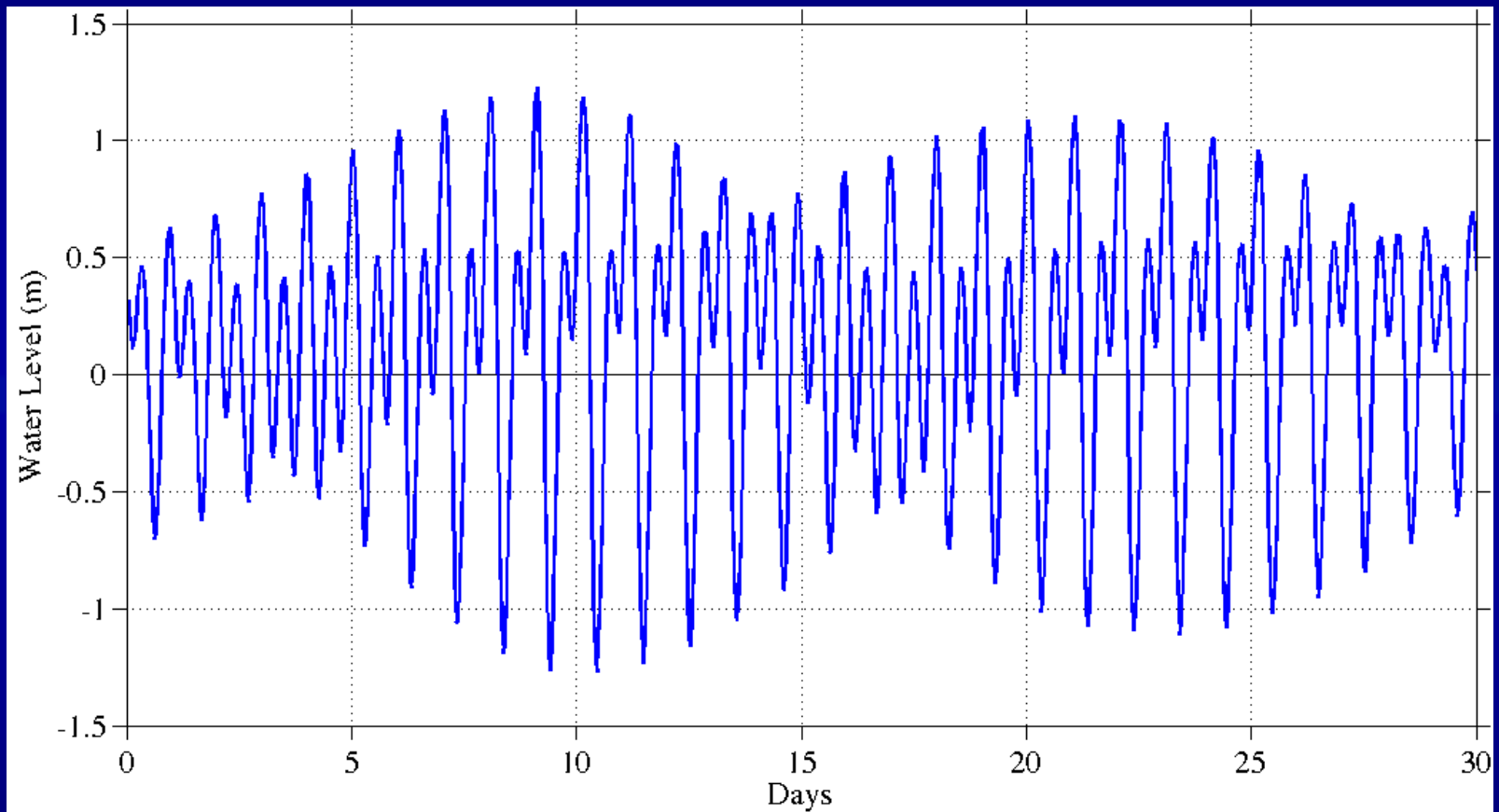
- Based mainly in LiDAR and photogrammetry
- 10-40 cm vertical accuracy
- Horizontal resolution of source data 1-5m
- Composite dataset res = 2m
- Photogrammetry work by Tom Coons, USGS (funded by CALFED)
- Napa R. watershed provided by Bill Dietrich and Ionut Iordache, UCB
- Preliminary Delta LIDAR data courtesy of Joel Dudas, DWR



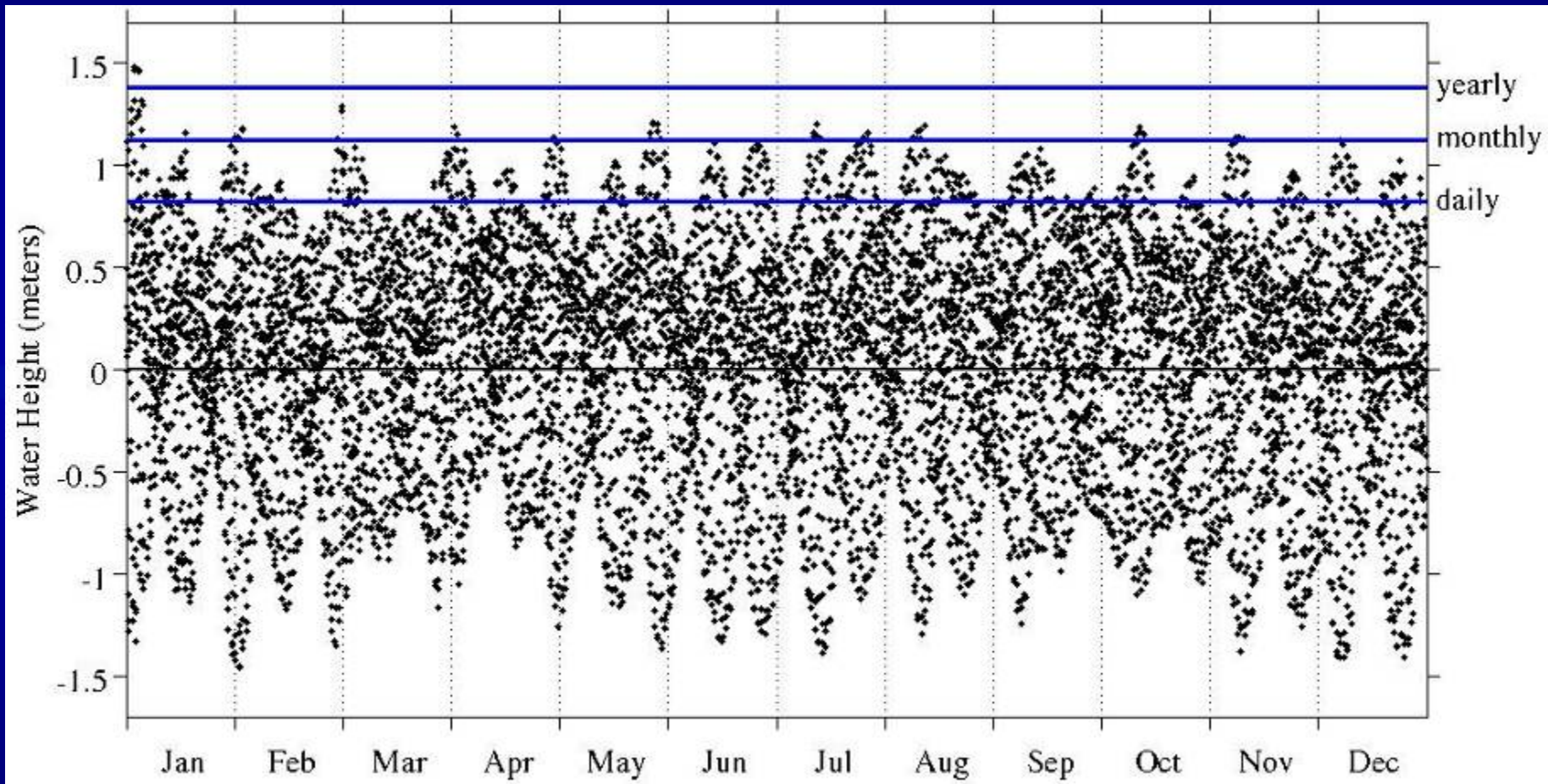
Tides vary around mean sea level on daily time scales...



...and also on monthly time scales, with a larger range.

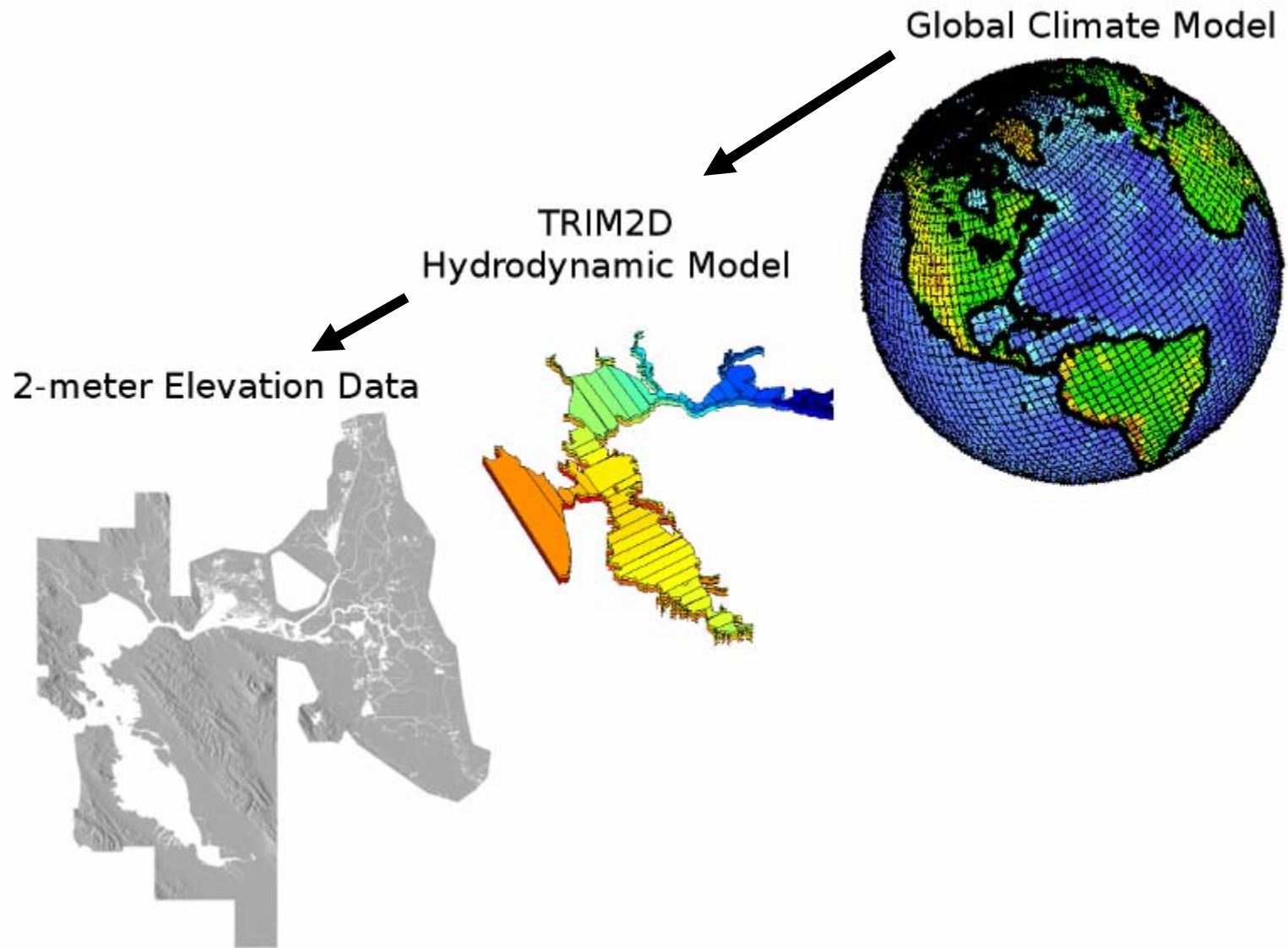


With long enough time series, recurrence levels can be determined.

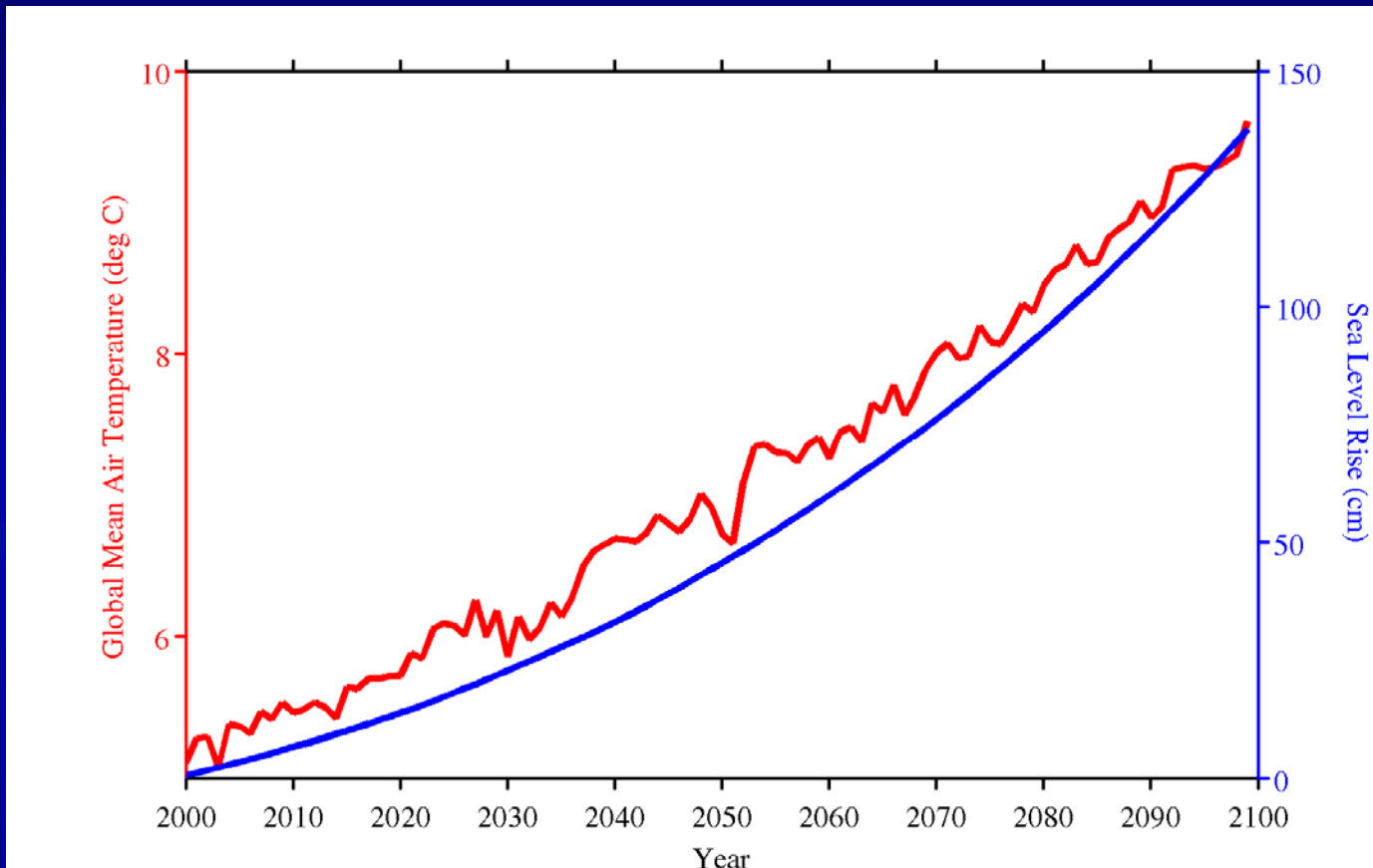


Hourly water level data (relative to MSL) for a typical year (2006).

# Modeling Sequence

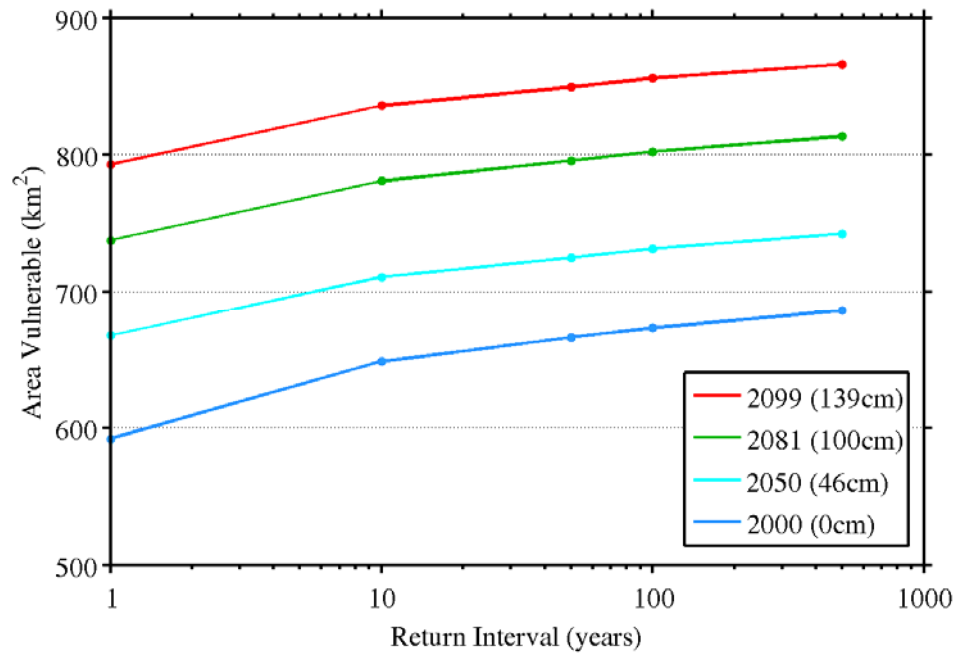
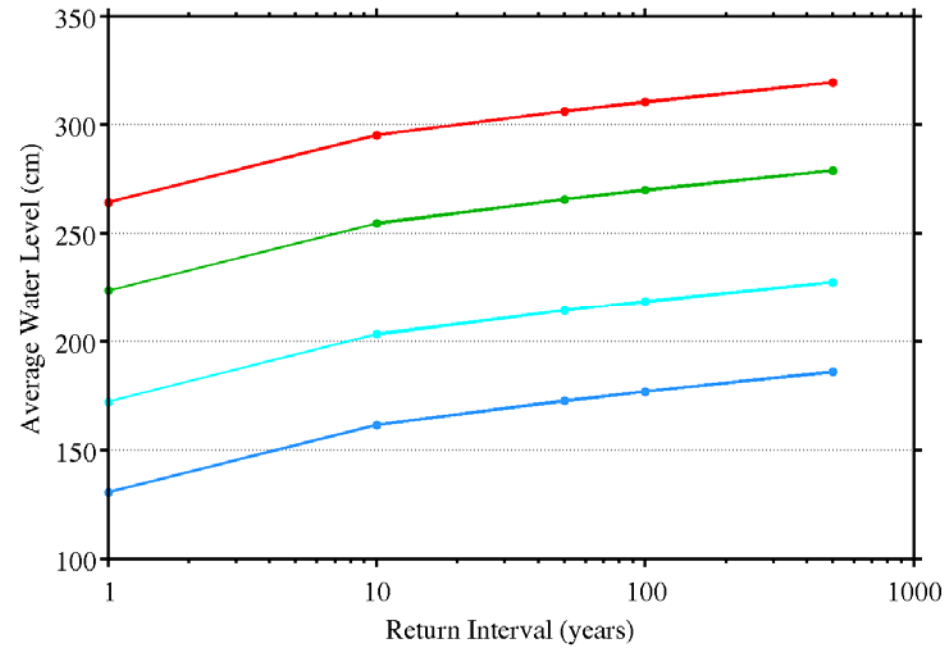


## Sea Level Rise Projection from CCSM3-A2

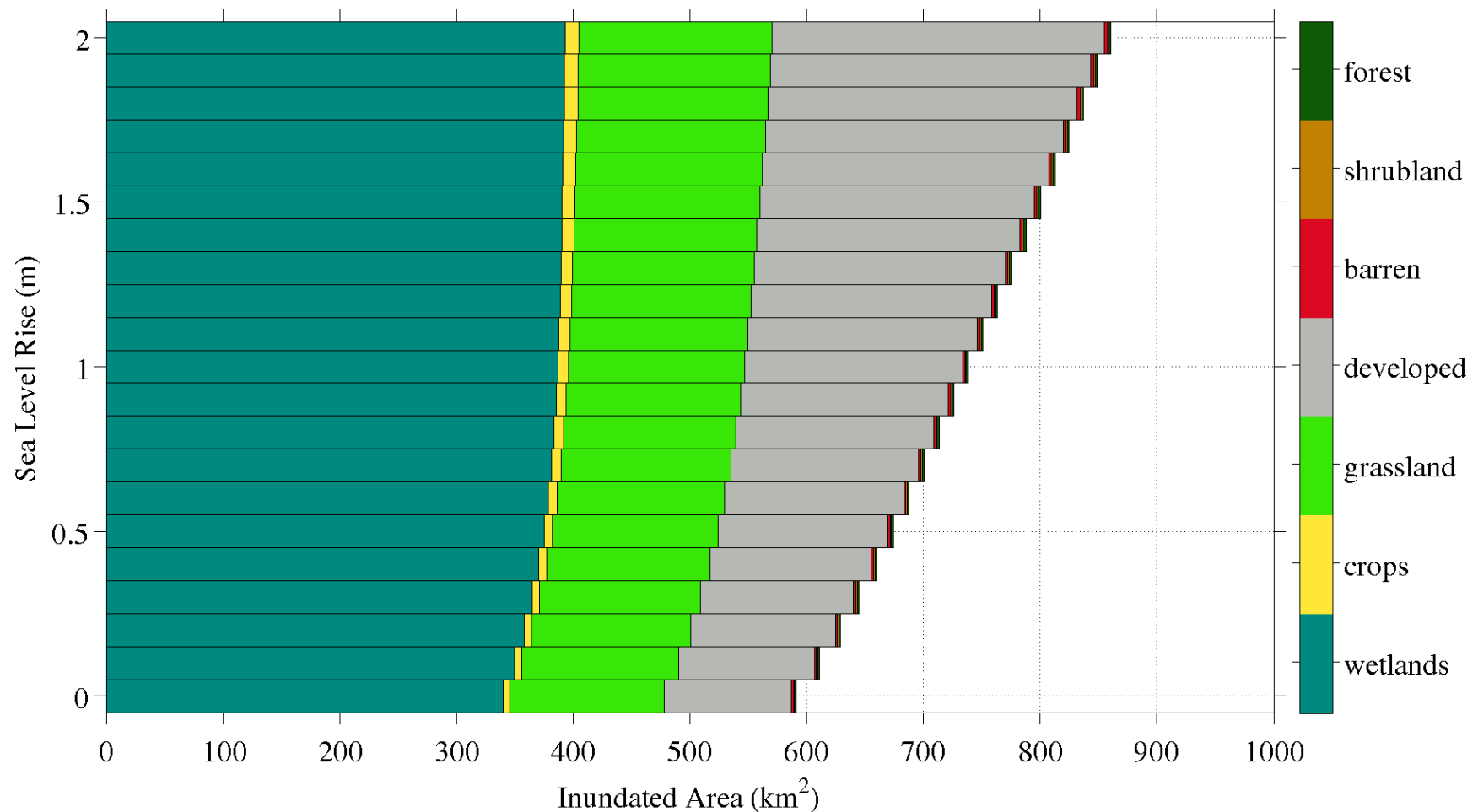


This sea level rise projection is from the Community Climate System Model (CCSM, v.3.0) using the A2 emission scenario. This projects a 4.5°C by 2100. The corresponding sea level rise projection is 140cm.

As early as 2050 under this scenario, the 1-year peak event nearly equals today's 100-year peak event.



We can also view the impacts in terms of land cover: NLCD2001

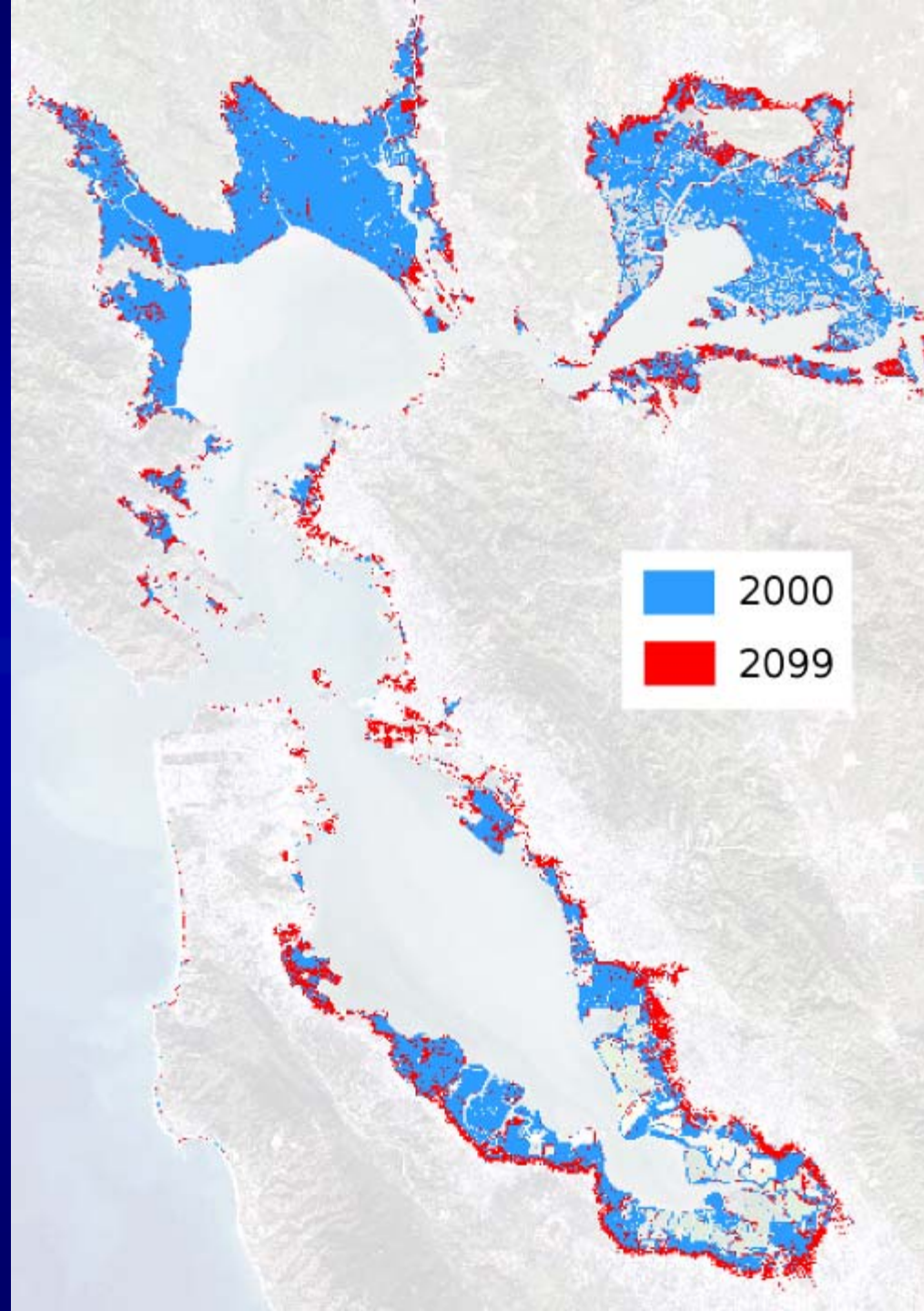


Main increase in at-risk area is in the “developed” land cover class.

land cover data from <http://www.mrlc.gov>

Areas inundated or at risk of inundation by average yearly high-water levels, for both present-day (blue) and projected 2099 (red) conditions, corresponding to a 140cm sea level rise.

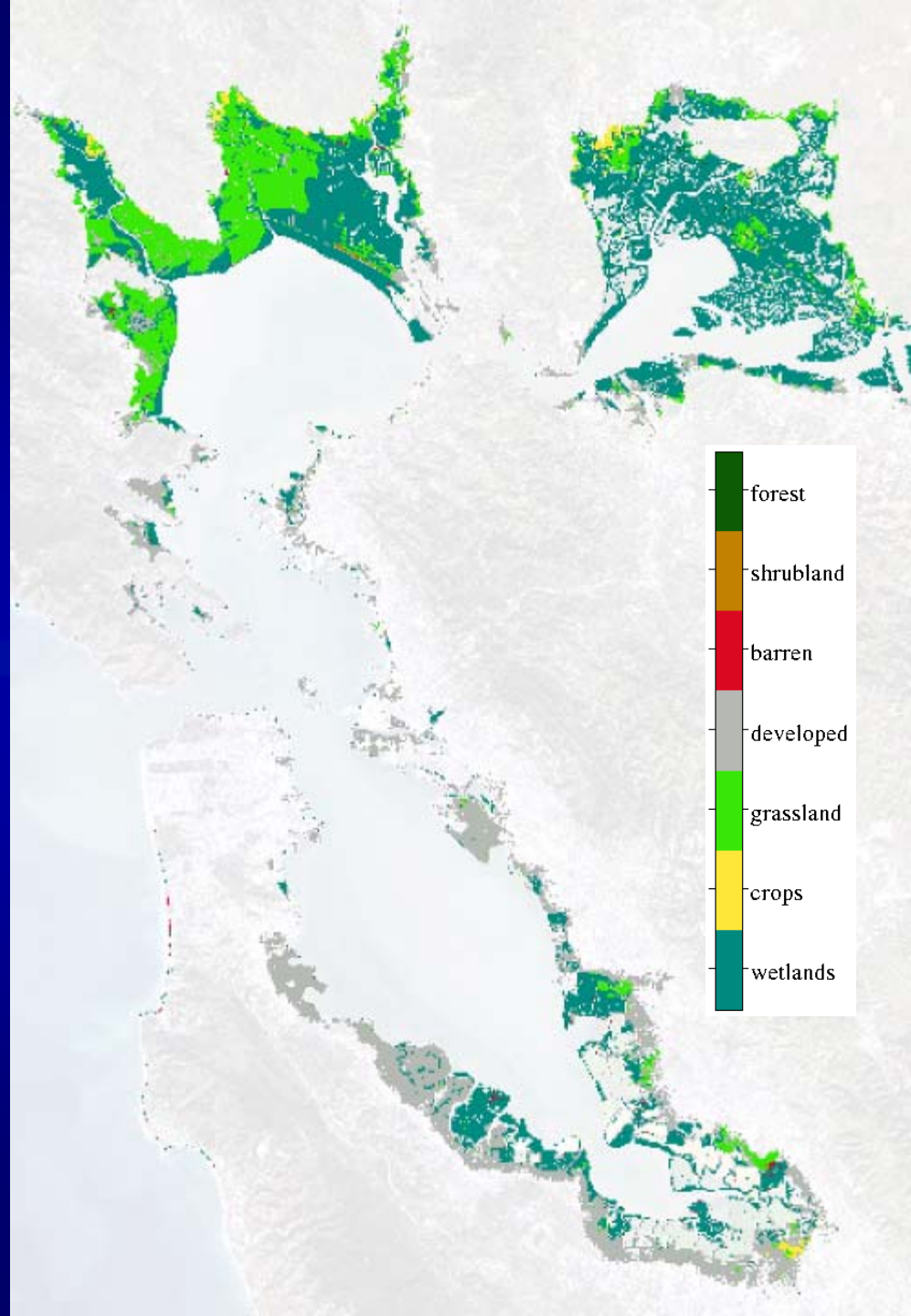
Many of these areas are currently protected by levees. They would be inundated only if those levees fail or are overtopped.



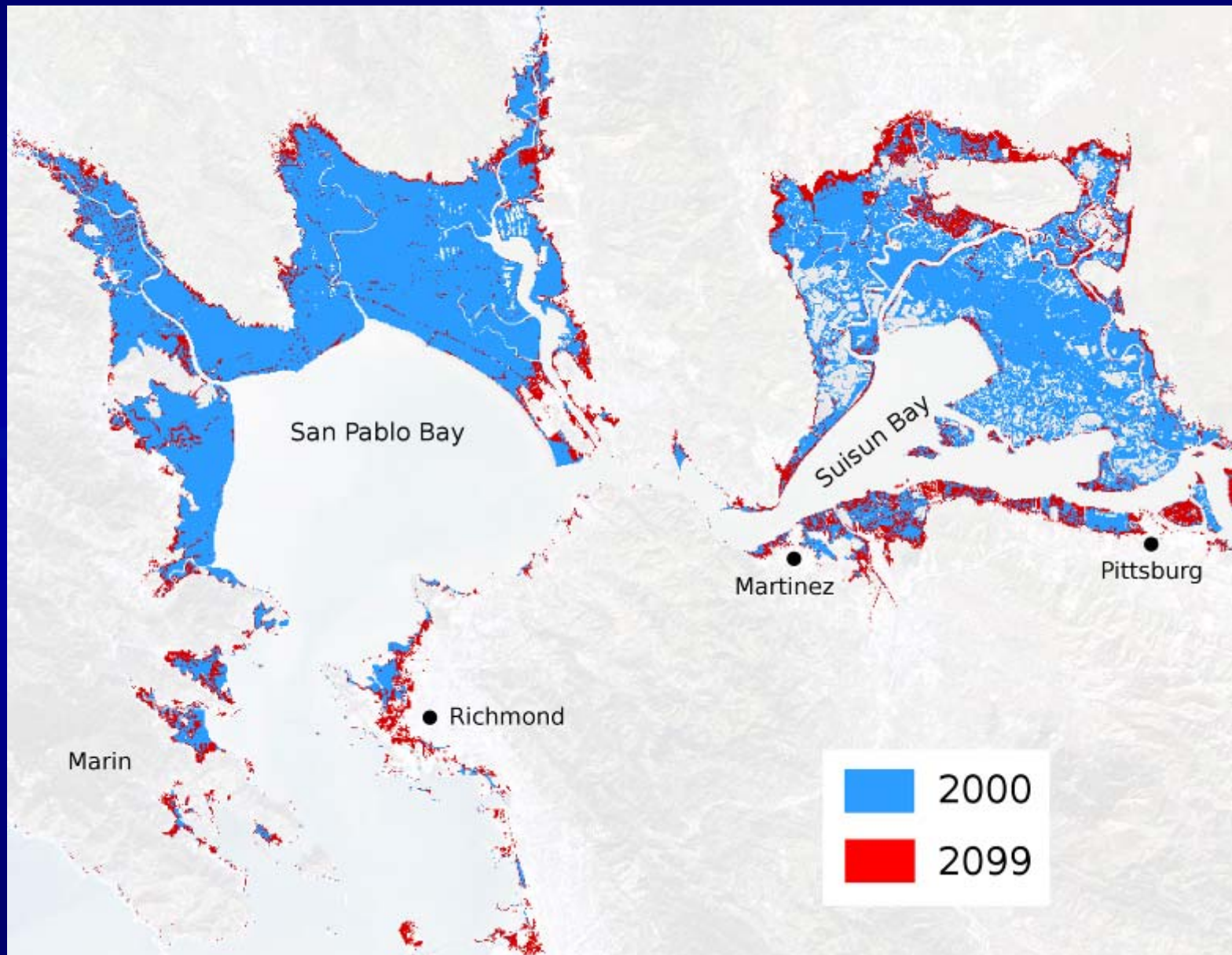
Areas inundated or at risk of inundation by average yearly high-water levels, under a 140cm sea level rise, coded by land cover type.

The bulk of vulnerable areas are composed of the wetlands and grasslands in North Bay.

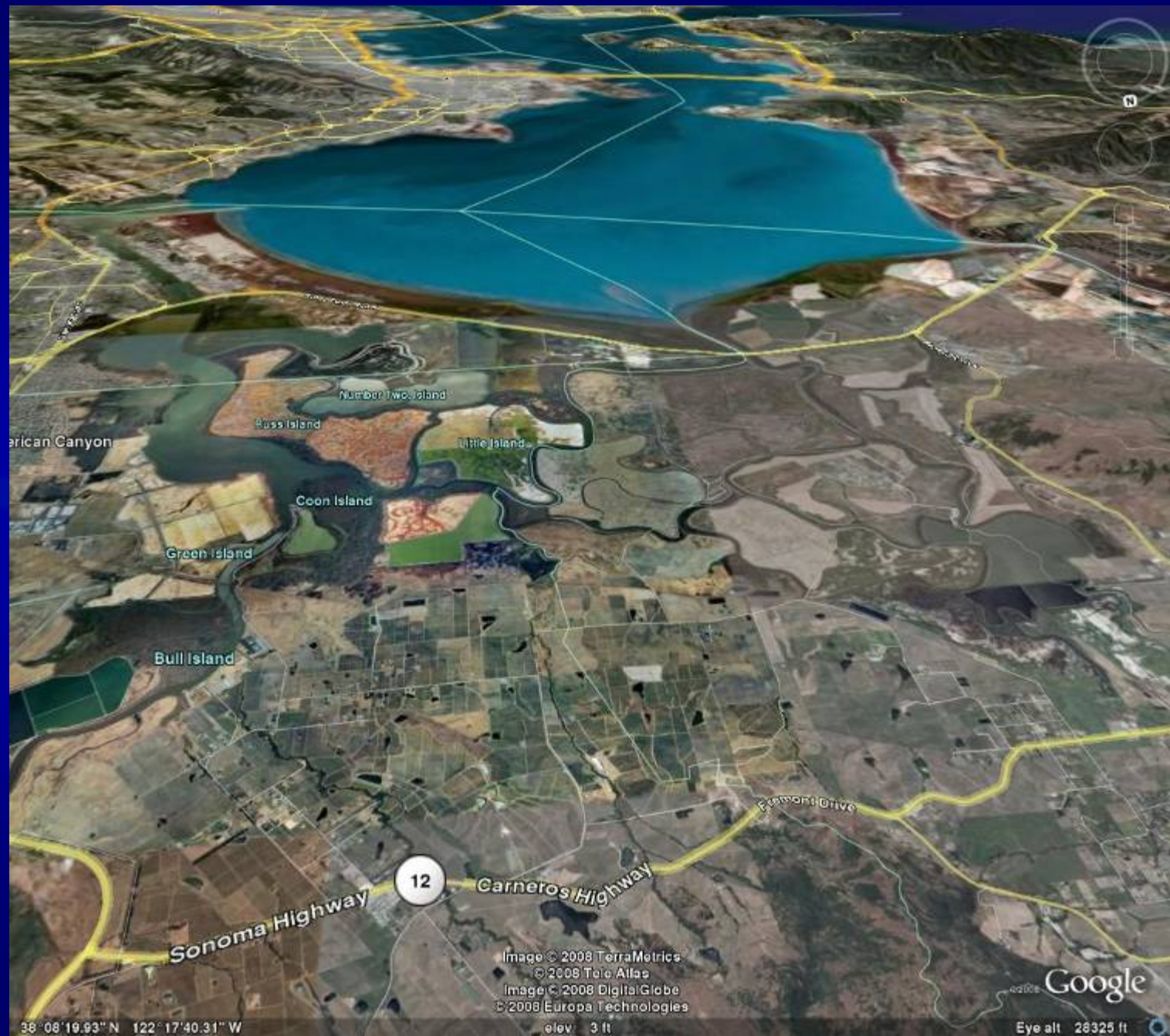
However, most *newly* vulnerable areas as a result of sea level rise are the developed areas surrounding Central and South Bays



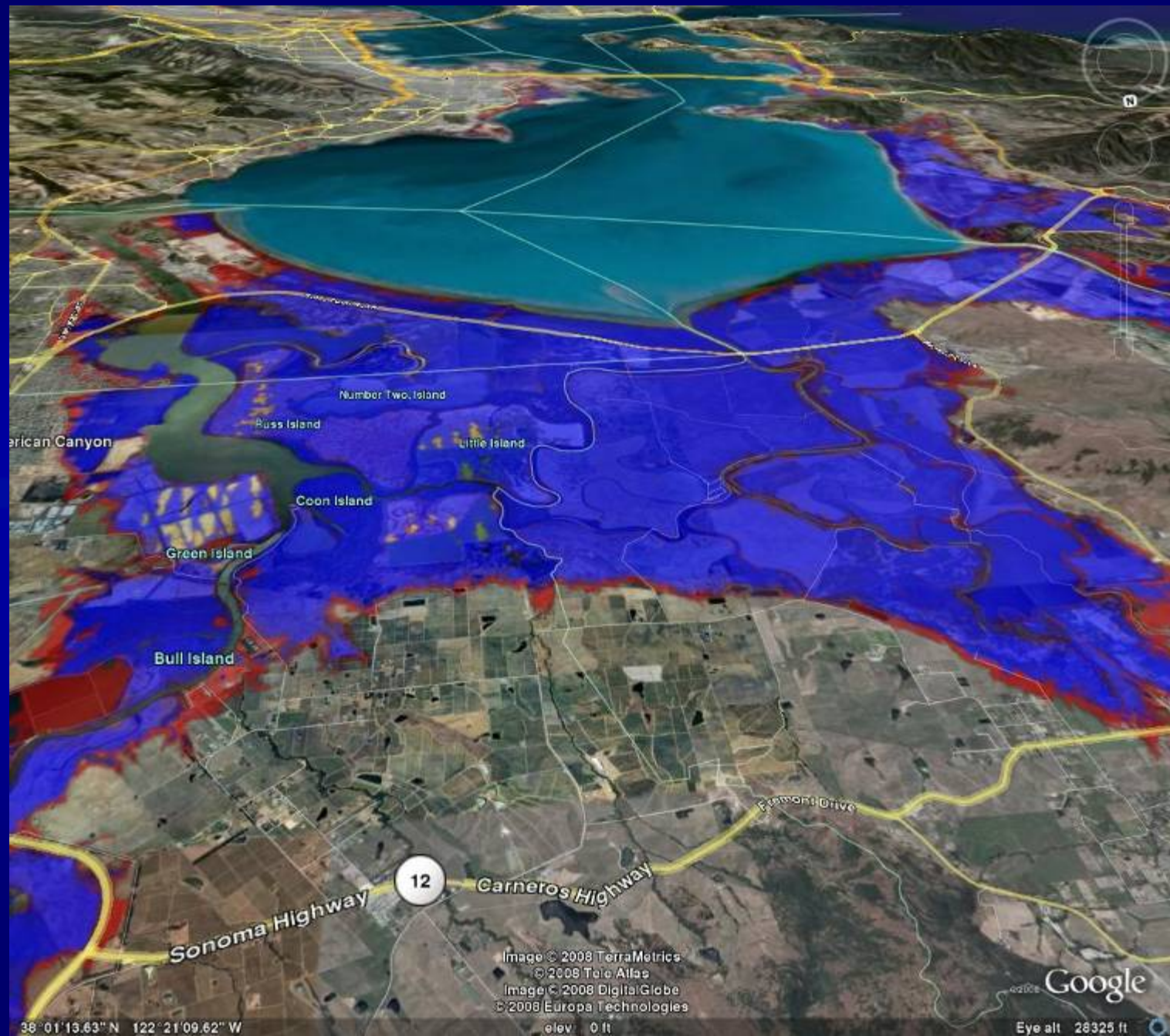
## North Bay: Napa and Suisun Wetlands



# North Bay: Napa Wetlands



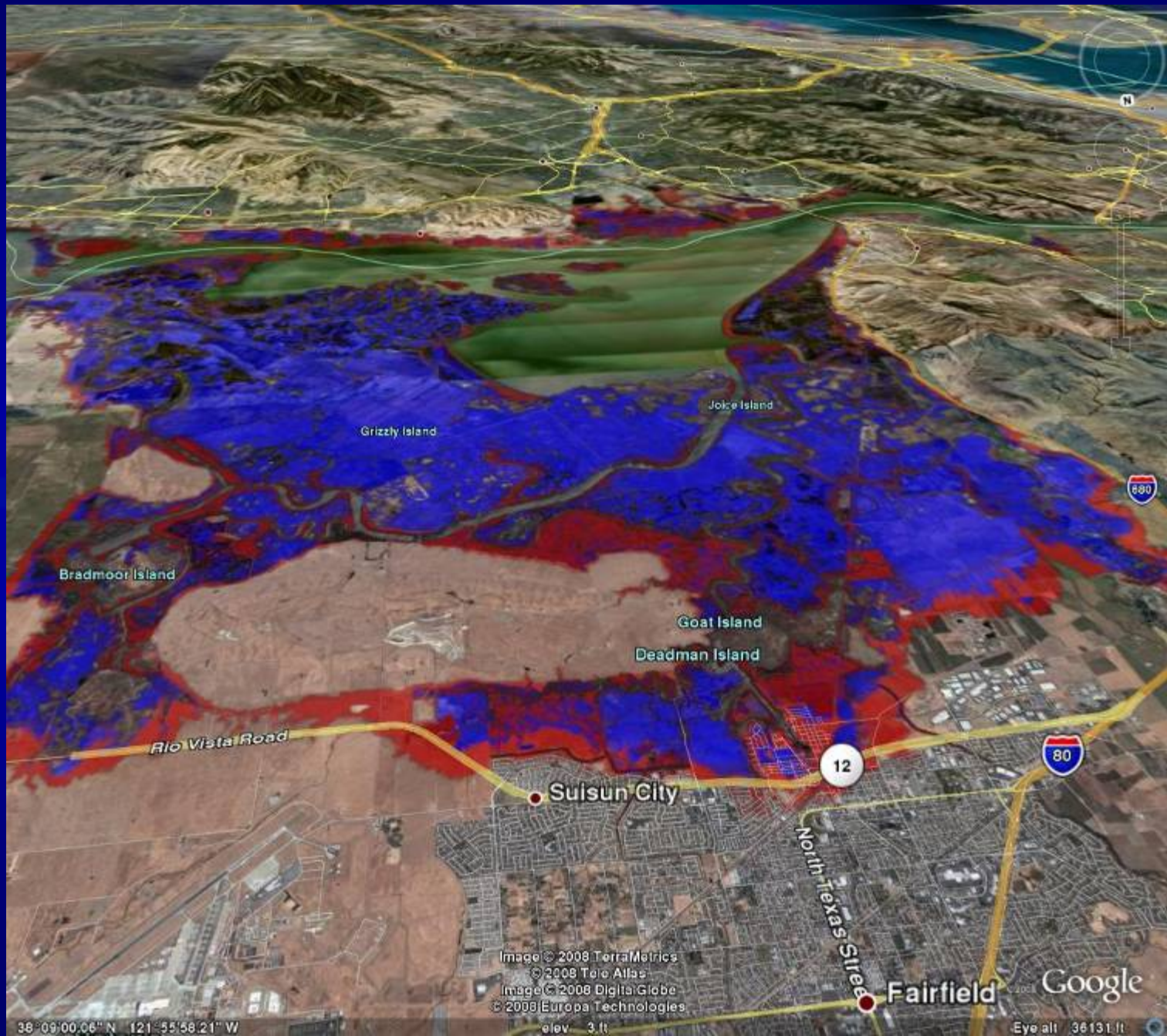
# North Bay: Napa Wetlands



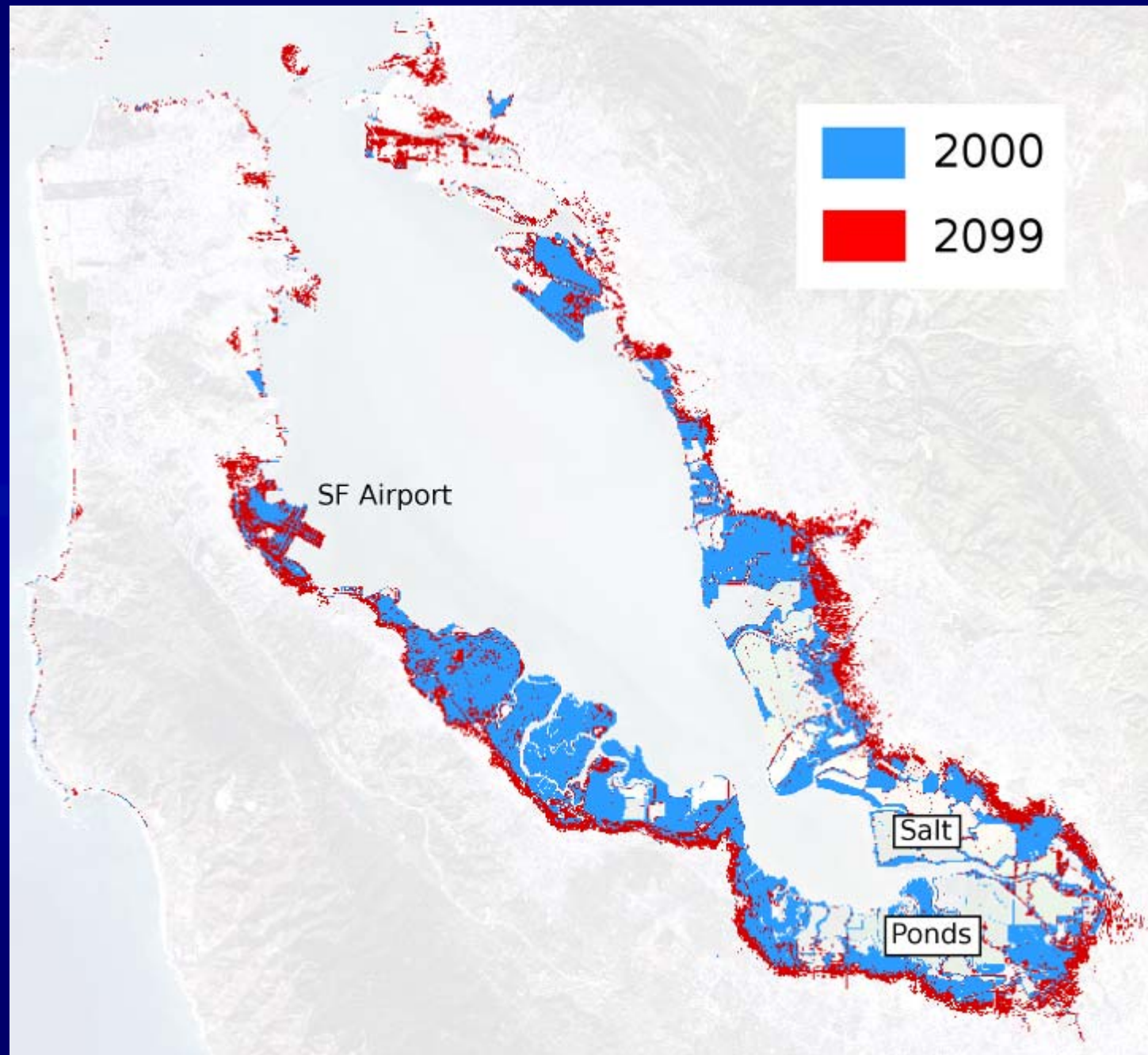
# North Bay: Suisun Wetlands



# North Bay: Suisun Wetlands



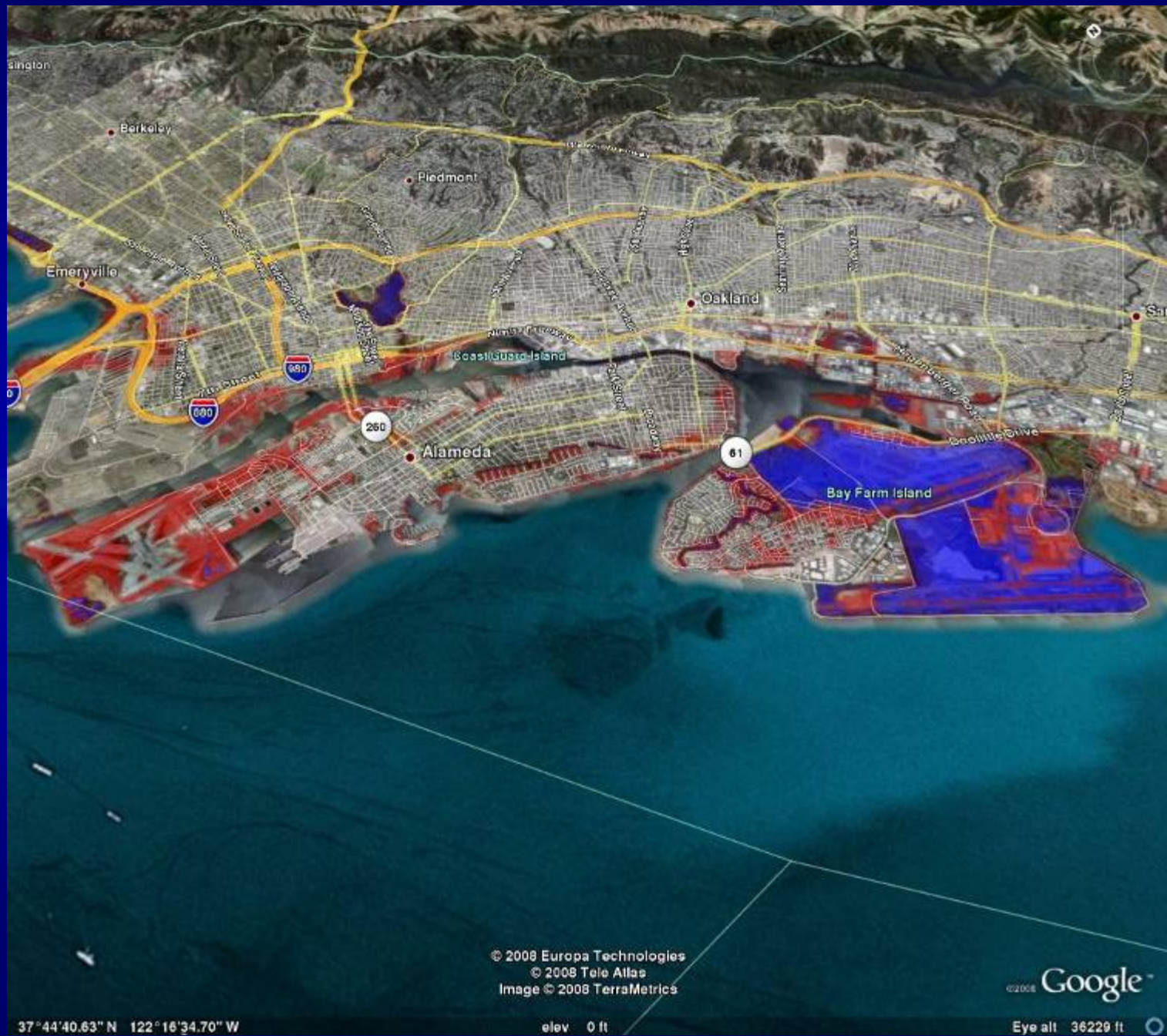
## South Bay: Salt Ponds and Developed Areas



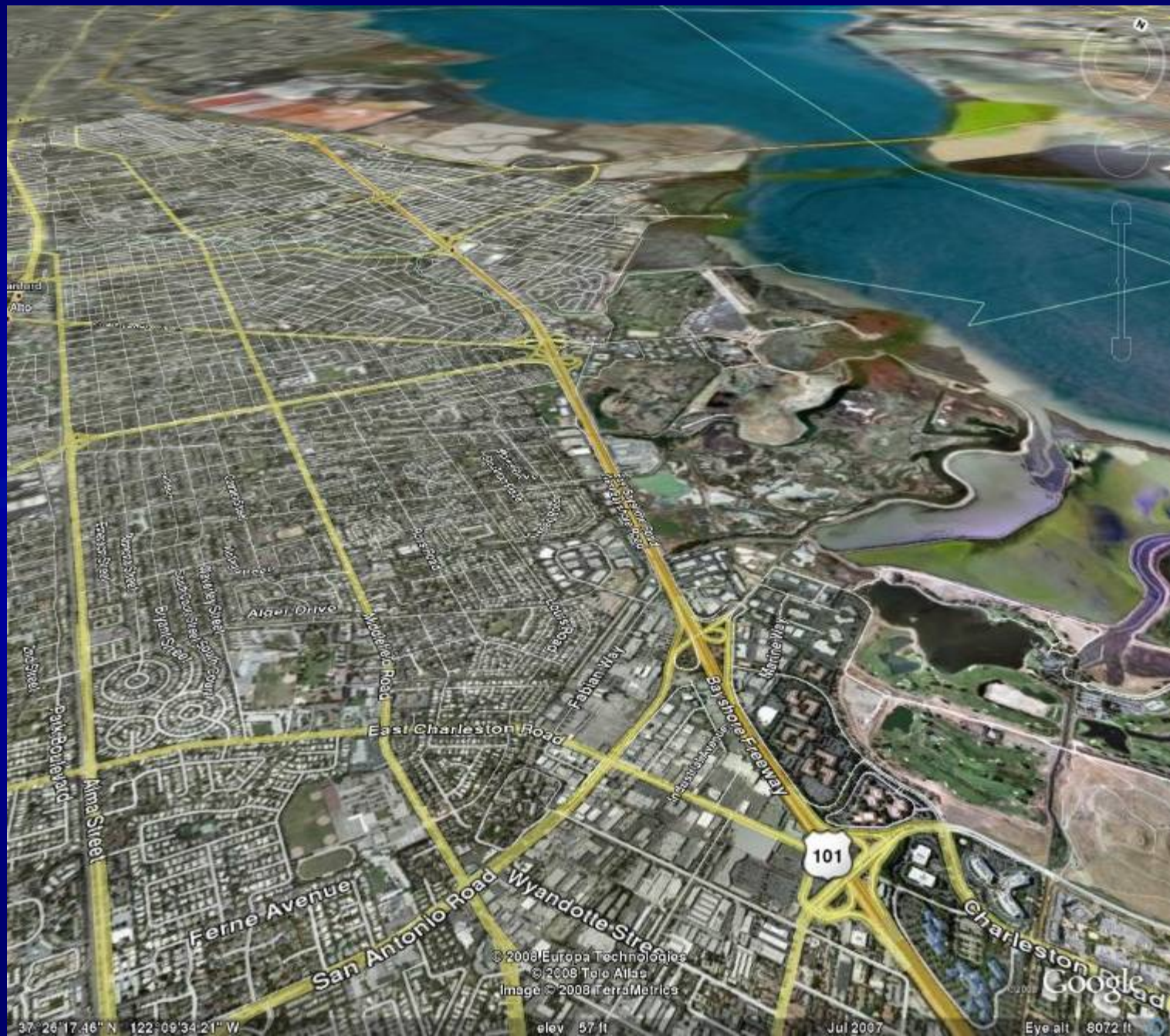
# South Bay: Oakland Airport and Alameda



# South Bay: Oakland Airport and Alameda



# South Bay: South Palo Alto



## South Bay: South Palo Alto



## Next Steps

- Publish in peer-reviewed journal and make all datasets and Google Earth interface publicly accessible
- Include levee height data and examine extreme events to assess overtopping potential
- Incorporate bathymetric data and address potential shifts in tidal zones and changes in shallow-water habitat
- Refine estimates of local mean sea level and signal attenuation in channels around Bay and in Delta

Thanks to Tom Coons for his work on the elevation dataset. Thanks also to the following who provided essential data: Joel Dudas, Bruce Jaffe, Amy Foxgrover, Theresa Fregosa, Cathy Ruhl, Brad Tom, Chris Enright, Bill Dietrich, Ionut Iordache, Tim Doherty, Jeff Mount, Ray McDowell

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